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Landscape degradation in the Jazan coastal desert: Understanding the impact of human activities

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Abstract

This study examines the landscape degradation of the Jazan coastal desert in Saudi Arabia and explores strategies to balance tourism development and environmental preservation. The Coastal Scenery Evaluation System (CSES) was utilized to assess the scenic quality of 42 coastal sites, revealing that most sites fell into Classes III, IV, and V. Factors such as coastal erosion, hard structures, urbanization, marine wrack, litter, sewage, and beach driving had a negative impact on the scenic quality of the coastal sites. To enhance the landscape of the Jazan coastline, it is important for the Kingdom of Saudi Arabia (KSA) to give primacy to approaches to the management of coastal scenery that maintain an equilibrium between promoting tourism and safeguarding the environment. These strategies should focus on preserving, enhancing, and restoring coastal scenic characteristics and incorporate the protection and restoration of ecosystems and habitats, sustainable use of resources, natural and cultural heritage conservation, a balance between protection and development, legal and institutional support, identification and assessment of scenic values, stakeholder involvement, resource provision for effective management, and promotion of research and evaluation. Successful implementation of these strategies will lead to increased tourist arrivals and a much-improved coastal management system in the Jazan coastline and other coasts in the Kingdom of Saudi Arabia experiencing similar development pressures.

Introduction

Deserts are geographic regions that receive very little precipitation, usually <250mm (10in.) of rain per year (Marsh and Kaufman, 2013). These areas are characterized by arid climates, sparse vegetation, and unique landforms shaped by the lack of water. Deserts can be found on every continent of the world, with the largest located in the subtropical and tropical regions (Tarbug and Lutgens, 2013). Deserts are the most extensive of the Earth's biomes, occupying more than one-third of the global land surface. There are four main types of deserts: hot and dry, semi-arid, cold, and coastal. Each type of desert has unique characteristics related to its climate and location, which affect the types of flora and fauna that can survive there (Laity, 2008).

A coastal desert is a type of desert that is located adjacent to a coastline (Martinez and Mitchell, 2017). It is typically characterized by its proximity to a cold ocean current that runs parallel to the shoreline, which creates a stable atmospheric condition that prevents significant amounts of rainfall. Coastal deserts are often found in regions where the prevailing winds blow from the ocean toward the land, causing the air to cool and lose its moisture as it rises over

the coastal mountains. As a result, these areas are often dry and arid, with little vegetation and limited opportunities for agriculture. Perhaps the most famous coastal desert in the world is the Namib Desert in Africa. This desert, as all coastal deserts, is home to a unique array of plant and animal life that have adapted to survive in the harsh desert environment (Laity, 2008).

Despite their extreme conditions, the strategic location between the sea and land makes coastal deserts an essential environmental hotspot that provides a range of ecosystem services. These services include regulatory functions such as sediment storage and ecological quality (Pilkey et al., 2022), as well as the provision of bioindicators for pollutant monitoring and environmental support (Ben-Haddad et al., 2022). Coastal deserts also provide cultural services such as recreational opportunities and spiritual enhancement (Rangel-Buitrago et al., 2022).

No matter deserts' extreme conditions, Humans, are leaving an indelible mark on these environments with a wide range of environmental impacts, such as i) habitat destruction and loss of biodiversity due to land use changes and development (Pilkey and Cooper, 2014); ii) coastal erosion due to sand mining (UN Environment, 2022; Pilkey et al., 2022); iii) overfishing and destructive fishing practices (Pauly, 2019); iv) pollution from sources such as oil spills, and marine debris, which harm both human and wildlife health in the coastal ecosystem (Williams and Rangel-Buitrago, 2019, Williams and Rangel-Buitrago, 2022).

Landscape deterioration refers to the decline in the visual quality or appearance of an area (Rangel-Buitrago, 2019), caused by various factors, including environmental pollution, physical damage, and neglect or lack of environmental awareness. (Alharbi and Rangel-Buitrago, 2022). Loss of landscape aesthetics also can be defined as any visible deterioration of the ecosystem's quality from a visual point of view (Portella, 2014). Although significant and of importance in terms of adverse effects on coastal ecosystems, landscape deterioration is often the least addressed type of coastal pollution. This type of pollution can arise from various sources and types and can result from a single or a combination of factors.

The Coastal Scenery Evaluation System (CSES) is an ecological indicator (scenic evaluation tool) commonly used to assess a coastal ecosystem's landscape quality and environmental health. Initially reported by Ergin et al. (2002) and updated by Rangel-Buitrago (2019), the Coastal Scenic Evaluation System (CSES) was established according to specialists with respect to assessment protocols derived from public surveys.

The CSES assesses the scenic quality of coastal sites using a combination of physical and human parameters, including natural features such as geology and vegetation, and human features such as buildings and infrastructure. The system uses a checklist of 18 physical and 8 human parameters to evaluate the scenic quality of a coastal site, which are then used to calculate a scenic evaluation index, known as the D Value. The D Value is a numerical score that ranges from I to V, with Class I representing top scenic areas and Class V indicating poor scenic areas with a high degree of human intervention. The CSES is a helpful tool for assessing a coastal area's scenic quality and environmental health and provides valuable information for management and planning.

Some of the parameters that are used in the system, such as litter, can provide an indication of the level of landscape deterioration in the coastal desert environment. For example, high levels of litter on the coast can be a sign of pollution, and can negatively impact the scenic quality of the area. By evaluating the scenic quality of coastal sites using the CSES, policymakers and managers can better understand the condition of coastal ecosystems and develop strategies to protect and restore these crucial environments.

The Kingdom of Saudi Arabia is situated on the Arabian Peninsula in the southwestern part of Asia and bordered by the Arabian Gulf and the Red Sea (Fig. 1). It has two coastlines. The Red Sea coastline extends approximately 1760 km, while the Arabian Gulf coastline stretches around 560 km. The Kingdom of Saudi Arabia's coasts, with their unique geological and geomorphologic conditions, as well as their rich culture, history, and unique nature, are ideal for the development of the tourism industry.

The government of the Kingdom of Saudi Arabia and specifically, the Ministry of Tourism, are cognizant that there are several possibilities for the expansion of the tourism sector along the country's coastline. Nationwide endeavours have predominantly focused on the encouragement of coastal adventure tourism; this is viewed as the fastest developing

and most lucrative type of tourism which has played a key role in local economies, e.g., in the Jazan Province, which is a coastal desert in the south-eastern region of the Kingdom of Saudi Arabia.

Tourism is a major industry in the Kingdom of Saudi Arabia. Prior to the coronavirus pandemic, statistics published by the United Nations' World Tourism Organisation (UNWTO) indicated that the average number of international guests visiting the nation per year was between 2004 and 2019 was 14.73 million. During 2004 and 2019, respectively, 8.62 million and 17.53 million visitors were reported, showing a 103.32% rise in tourism over this period. According to the Ministry of Investment, during the initial half of 2022, the visitors number recorded was 46 million; international tourist spending was noted to be 27 billion riyals (U.S. $7.2 billion).

However, not all that glitters is gold. Coastal tourism can have both positive and negative impacts on ecosystems (Jones and Phillips, 2011). On the positive side, jobs are created, economic growth stimulated, and awareness increased of the importance of protecting and preserving natural areas. However, tourism can also negatively impact ecosystems, such as habitat destruction, alteration of natural landscapes, and increased pollution from increased human activity, including waste disposal and transportation. Additionally, coastal tourism can contribute to the overuse of resources, such as water and energy, which can adversely affect ecosystems (Mejjad et al., 2022).

Coastal tourism, particularly in the Jazan area, is threatened by a specific problem: Landscape deterioration. Degradation of the coastal desert landscape due to pollution can elicit adverse reactions from tourists, creating a sense of uncleanliness and reducing landscape value. These changes are sufficient to deter visitors from travelling or residing within these locations (Cendrero, 1989; Peña-Alonso et al., 2018; Rangel-Buitrago, 2019). Data for the Jazan region reflect that adverse alterations in the landscape quality of the areas have risen along with the local increase in tourism (Alharbi, 2020). Without intervention, the thriving coastal tourism industry could face serious challenges that impede correct development.

Unattractive visual conditions can lead to reduced funding and resources allocated to maintaining and conserving ecosystems. Additionally, the improper development (overdevelopment) of infrastructure to support tourism, such as hotels and restaurants, can lead to habitat destruction and fragmentation, adversely affecting wildlife and natural resources related with this coastal desert. Furthermore, the improper disposal of waste and litter from tourism can also negatively impact the environment, including marine and wildlife.

The previous information raises an important question: How can we address landscape deterioration and enhance or restore the scenic quality of the Jazan coastal desert for the ecosystem's benefit?

The main objective of this study is to conduct a scenic evaluation of 42 coastal locations in the Jazan area of the Kingdom of Saudi Arabia using the Coastal Scenery Evaluation System (CSES). The degree of landscape deterioration is determined by utilizing this assessment and classification methodology as an ecological indicator. An effective management strategy is developed based on knowledge of scenery to maintain, preserve, and sustainably utilize this ecosystem.

Section snippets

Study area

The scenic assessment presented in this work was developed on 42 coastal sites distributed along a 128 km coastal strip located between 17° 36′ 21.78" N and 16° 59′ 13.42" N (Fig. 1 and Table 1). The area comprises three governorate, Sabya, Baysh, and Ad Darb, arranged in a south-to-north direction, featuring expansive, low-lying beaches interspersed with numerous wadis typical of coastal deserts (dry riverbed or valley only contains water during periods of heavy rainfall or flash floods). The…

Methodological approach

In a first step, each coastal site was classified according to the typology definition expressed in the Bathing Area Registration and Evaluation (BARE), a systematic method developed by Micallef and Williams (2003). This

classification divides the beaches into five classes considering their environment, accessibility, accommodation grade, facilities, and safety equipment. The four categories found in this work are:

Industrial: include areas predominantly zoned general industry or equivalent…

Sites distribution

Forty-two coastal sites were categorized in the Jazan area in the Kingdom of Saudi Arabia. Scenic evaluation organized sites into three of the five available. Fifteen sites (36%) appeared in Class III, 15 (33%) in Class IV, and thirteen sites (31%) in Class V. Class I and II sites were not found in the study area (Table 1). Overall results represented in percentage and by typology are shown in Fig. 2 and summarized as follows:

Class III: are sites with D values that range between >0.40…

Conclusions

Coastal deserts are unique ecosystems that provide essential ecosystem services, including regulatory and cultural functions. However, human activities have adversely affected these environments, leading to landscape deterioration and other environmental problems. The Kingdom of Saudi Arabia's coastal desert is a prime location for tourism development, but this development must be balanced with conservation and management strategies to avoid further degradation.

The Jazan coastal desert has been …

CRediT authorship contribution statement

Omar A. Alharbi: Conceptualization, Writing – original draft, Writing – review & editing. **Nelson Rangel-Buitrago:** Conceptualization, Writing – original draft, Writing – review & editing.…

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

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